



PRODUCTIVITY IMPROVEMENT
USING INDUSTRIAL ENGINEERING TOOLS (SMEs COMPANY)

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ABSTRACT

The aim of this study is to study the implementation of industrial engineering tools in selected manufacturing company to identify the highest defects occurred at the company production lines and propose new methods to the selected manufacturing company for defects reduction and thus improve the productivity of the company. The chosen company is Global Factor Sdn Bhd and the product being analyzed is marker pen. The production process of marker pen is studied to understand the overall process flow before the studied can be starts. The study mainly focuses on 7 Quality Control but not all of the tools are used in this study research. The selected tools used are Check Sheet, Pareto Diagram, Cause and Effect Diagram, and Flowchart. The main product in this company is marker pen which are almost totally the process is in house production. Every product defects is jotted down into check sheet. Next, the data is arranged in descending from the highest frequency to the lowest frequency defects to form a pareto chart. So, the highest frequency can be determined to analysis purpose. Miss printing shots has the highest frequency thus selected to be analyzed. Then, the cause and effect diagram is drawn as the miss printing shots is the effect while the cause of effect is determined by 4M (Machine, Man, Method, and Material). From cause and effect diagram, only a few causes that contributes the most to defects is selected to be discussed with the operator of the machine. The solution to the problems is suggested to the company to apply. One of the solutions is combine the used printing film with the new printing film using cellophane tape. The cost involved in the implementation of new method is calculated. The result of the new and the original method is compared to review the performance of the company. The result of comparison of the new and the original method is the answer of the improvement of the productivity.

ABSTRAK

Tujuan utama kajian ini dijalankan adalah untuk melaksanakan teknik industri di syarikat di industri kecil dan sederhana (IKS) yang dipilih untuk mencari kecacatan tertinggi yang berlaku di pemprosesan di kilang tersebut dan mencadangkan penyelesaian terbaik untuk mengurangkan kecacatan yang akan berlaku di syarikat IKS yang dipilih sehingga meningkatkan produktiviti syarikat. Syarikat yang dipilih untuk menjalankan kajian ini ialah Global Factor Sdn Bhd milik bumiputera. Penyelidikan ini tertumpu pada “7 Quality Control Tools” yang merupakan teknik yang digunakan dalam teknik industri. Proses pengeluaran produk di kilang tersebut haruslah difahami untuk melancarkan kajian penyelidikan keatas produk yang ada di kilang tersebut. Produk utama di kilang Global Factor Sdn Bhd ialah marker pen yang dihasilkan sepenuhnya di kilang tersebut. Setiap frekuensi kecatatan produk di kilang tersebut direkodkan ke dalam check sheet yang disediakan. Kemudian, data-data yang direkod itu disusun mengikut turutan dari frekuensi kecatatan yang paling tinggi ke frekuensi yang paling rendah untuk diterjemahkan ke dalam pareto chart. Dengan secara langsung, kecatatan yang paling banyak berlaku dapat dikenali dan dipilih untuk dijalankan analisis secara lebih mendalam. Tembakan percetakan yang terlepas memiliki frekuensi kecatatan yang tertinggi dan dipilih untuk dianalisis. Seterusnya, cause and effect diagram dilakar untuk tembakan percetakan yang terlepas dan sebab-sebab berlakunya kecacatan harus dicatatkan melalui 4M iaitu “Methods”, “Machines”, “Mans” dan “Materials”. Melalui cause and effect diagram ini, hanya beberapa sebab yang terbesar yang menyumbang kepada frekuensi kecacatan tertinggi sahaja akan dipilih untuk dibincangkan. Melalui kaedah ini, beberapa penyelesaian telah dicadangkan kepada Global Factor Sdn Bhd. Antara penyelesaiannya ialah mencantumkan gulungan film yang baru dengan gulungan film yang lama menggunakan pita selofan. Pengurangan kos untuk penyelesaian yang dicadangkan dikira untuk meningkatkan produktiviti syarikat.

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CHAPTER 1

INTRODUCTION

1.1 Overview of The Project

Many organisations are nowadays interested to adopt lean manufacturing strategy that would enable them to compete in this competitive globalisation market. Lean manufacturing is becoming lean enterprise by treating its customers and suppliers as partners. This gives the extra edge in today's cost and time competitive markets (Hudli and Inamdar, 2010).

To compete in competitive world, the SME, have the alternative to strike for world class performance through implementation of Lean Manufacturing (Rose, 2009). Various industrial engineering technique and tools is implementing in this study in order to investigate and solve the problem that occurs in the company. The tools selected to used in this company is industrial engineering tools.

Data for the selected department are collected, studied and analyzed. The defect with the highest frequency will be the main target to be improved. Various causes of the defect will be analyzed and various solving method will be present. The best solving method will be chosen and propose to the company and will be compared to the previous result or production. The improvement of productivity is the result of comparing the previous result with the new result after the implementation of the new method proposed.

1.2 Problem Statement

Nowadays, the most important goal for almost all company whether small or medium size of business is to increase the productivity in order to fight the competitiveness challenge. They are many strategies and methods exist by which productivity could be analyzed and improved.

Simulation software such as Quest, ProModel, and WITNESS allow users to build several layout of the company and identify the problems faced and hence improve the productivity of the company. Another method that can be used in this study is industrial engineering tools. Many industrial engineering tools can be used to improve the productivity of production, services and management. However, the analysis of problems consume of longer time compare with the simulation software.

This study tries to identify the defects occurs on products, and hence overcome to reduce the defect that occurred during the productivity process. The existence of defect could affect the production costs. The reduced cost could be increase the sales hence increase the profit to the company.

1.3 Objectives

Objectives of this study are to achieve the following:

- (i) To implement industrial engineering tools in selected SMEs company.
- (ii) To identify the highest frequency defects existed in the selected SMEs company.
- (iii) To propose the best solution to overcome the problem to the company.
- (iv) To improve the productivity of the company.

1.4 Scope

The scope of this study are:

- (i) Research was done at Global Factor Sdn Bhd, a SMEs company fully owned by Malaysian citizen.
- (ii) The study mainly focuses on 7 Quality Control tools but only selected Quality Control tools are applied. They are Check Sheet, Pareto Chart, Cause and Effect Diagram and Flow Chart.
- (iii) This project evaluate the effectiveness of company production performance based on the current company achievement using the industrial engineering tools.

1.5 Expected Outcome

At the end of this study, the findings could identify the main cause and possible solutions for the studied SME. Therefore, the new process or system could increase productivity and also will eliminates identified defect.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the tools in the industrial engineering to be applied to small and medium sized companies. Productivity, performance and quality is always focused on business development. There are many techniques available in problem solving, ranging from simple and easy to use methods to relatively complicate and advance statistical tools. TQM tools are the popular techniques used by small and medium companies to improve their management quality of business. Although the methods used to analyze the data seem simple, but effective way to identify, analyze and solve problems faced by the company. Disseminate information on IE tools and SMEs obtained through articles, journals and books.

2.2 Introduction to Productivity

Productivity is a very important measure in manufacturing operations. Besides turnover and profit, it provides insight into the efficiency and effectiveness of any operations. Productivity improvement will have a positive impact on the direct costs of the products, as the same output is produced with less input or as the same inputs are producing more output. This can create new opportunities and improve the competitiveness in manufacturing operations.

Productivity is one of the key factors affecting the overall competitiveness of a company. Productivity can be managed in different levels – on national, sector or enterprise level. In the enterprise level there are also different possibilities for

productivity management, e.g. different measures of productivity can be used or different levels regarded. At a cluster level, knowing the real-time functionality expectations and evaluating the experience on speed performance and limits of data interaction amount of commercial solutions drive the cluster to build up a new system (Behjat, 2003).

According to Tangen (2002), The concept of productivity, generally defined as the relation between output and input, has been available for over two centuries and applied in many different circumstances on various levels of aggregation in the economic system. It is argued that productivity is one of the basic variables governing economic production activities, perhaps the most important one.

According to Riikka and Antti (2007), Productivity is a key determinant for the success of any organisation. This holds true also in the case of knowledge-intensive organisations. Traditional productivity measures are based on measuring the quantities of outputs (i.e. products and services) produced as well as the inputs used in the production process. However, these quantitative methods cannot usually be applied to knowledge work because of, e.g., the qualitative nature of the output of knowledge work. Therefore, there is a need for a new measurement method that knowledge-intensive organisations could use in managing their productivity.

Productivity is defined as a relationship (usually a ratio or an index) between output (goods and/or services) produced by a given organizational system and quantities of input (resources) utilized by the system to produce that output. In economics, productivity is often measured as ratio output changes over input changes. However, at the field of management accounting, productivity is usually defined as the ratio of output over input. This definition can be directly connected to the financial effects of productivity changes. For example, the cost effect of input changes can be directly calculated when the amount and the unit cost of the input are both known. From the managerial perspective operating with output and input levels instead of changes seems to be more relevant (Mika, 2000).

The main purpose of implementing lean manufacturing is to increase productivity, reduce lead time and cost and improve quality thus providing the up most value to customers. There are many descriptions regarding lean manufacturing. It is most frequently associated with the elimination of the seven important wastes to make the effects of variability in supply, processing time or demand. The seven wastes mentioned are: over production, waiting, unnecessary transport or conveyance, over processing or incorrect processing, excess inventory, unnecessary movement and defects (Hudli and Inamda, 2010).

Productivity has become a household word as almost everyone talks about it. Yet, the term 'productivity' means different things to different persons. As a phenomenon, it ranges from efficiency to effectiveness, to rates of turnover and absenteeism, to output measures, to measure of client or consumer satisfaction, to intangibles such as disruption in work flow and to further intangibles such as morale, loyalty and job satisfaction (Oyeranti, 2000).

A productivity measure, until recently, was a measure of the average product of some class of productive services. When they began to be calculated on a large scale it was already a basic proposition of economics that one should never look at average products, only at marginal products (Stigler, 1961).

Jergeas (2009) conducted another research based on Hewage (2007) fifty one factors affecting productivity. These factors were prioritized and clustered into nine categories. These categories are: design and changes, worker motivation, inadequate communication, worker skills, non-availability of information, lack of planning, congested work areas, inadequate supervision, and adverse weather conditions. University of Calgary research identified the relative importance of 51 productivity factors which were classified into three groups: Human, External, and Management.

According to Jergaes (2009), There were some of the significant situations that create congestion and reduce the productivity of resources in the work area. Some of the critical situations were over stacking of trades, improper activity sequencing, excessive on-site prefabrication & storage of material in the work area and improper planning of

the activities with regards to movement of resources in the work area with the progression of the work.

According to Dubelaar, Bhargava and Ferrarin (2002), based on research Good (1984) provides a list of outputs such as number of transactions, physical units sold, value added, sales, etc., and inputs such as hours of labour employed, number of employees, wages, salaries, etc. Given the use of multiple outputs and inputs, it would be easy to develop a number of simple ratios that measure different facets of productivity.

The overall performance of a company is comprised of seven criteria: effectiveness, efficiency, quality, productivity, quality of work life, innovations, and profitability. Productivity is thus an important success factor for all organizations. Improvements in productivity have been recognized to have a major impact on many economic and social phenomena. Companies must continuously improve productivity in order to increase the business profit.

2.3 Introduction to Industrial Engineering

Industrial engineering was originally founded as a discipline that focused on the study and design of work (Bailey and Barley, 2002). Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.

At the turn of the century, Frederick Taylor revolutionized the design and improvement of work with his ideas on work organization, task decomposition and job measurement. Taylor's basic aim was to increase organizational productivity by applying to human labor the same engineering principles that had proven so successful in solving technical problems in the workplace. The same approaches that had transformed mechanical activity could also be used to structure jobs performed by

people. Taylor, rising from worker to chief engineer at Midvale Iron Works, came to symbolize the ideas and practical realizations in industry that we now call industrial engineering (IE), or the scientific school of management. In fact, though work design remains a contemporary IE concern, no subsequent concept or tool has rivaled the power of Taylor's mechanizing vision (Davenport and Short, 1990).

One of the important Industrial Engineering activities is to analyze the job or workplace. This is to be used for quality and productivity improvement specially the workers activity, working space, materials, machines, jigs and fixtures, tools and other equipment in the furniture production department.

Today, many production systems are so complex that relevant knowledge has become differentiated and distributed across the organization. Under these conditions, advocating worker autonomy may cause unanticipated problems while not necessarily achieving productivity gains, as Bailey and Barley (2002) discovered among team programs in semi-conductor manufacturing. She found that as production operators took on preventative maintenance and gained greater autonomy, they threatened the job security of equipment technicians. Thus, the field needs new theories and methods tailored to a highly educated work force and to a variety of sophisticated workplaces.

2.4 Seven Quality Control Tools

To solve any problem, one should know the root of the problem, and know how to solve the problem. Sometimes, somebody does not know even figured out whether he or she is actually facing a problem. Then, how could he or she find the solution? In business management, it is worse if a company does not noticed the problem exist in their company. There are the techniques to identified the problem occur. One of the techniques is TQM tools or in popular term known as 7QC tools. The 7 QC tools are easier to apply and understand and yet proven scientific management tools.

According to Zakuan, Yusof and Shamsudin (2007), based on the study conducted by Woon (2004) among Singaporean companies found that the service

organizations generally showed a lower level of TQM implementation than the manufacturing organizations in the elements quality information and analysis.

7 QC tools can be used in all process phases, starting from the beginning of a product development up to management of a process, on day to day basis, and in systematic manner. They form the fundamental foundation for all problem solving and quality control activities.

The list of tools in 7 QC tools are check sheet, Pareto chart, flowchart, cause and effect diagram, histogram, scatter diagram and control chart (Ishikawa, 1985). These 7 QC tools also known as Total Quality Management (TQM) tools (Jay and Barry, 2008).

2.5 Check Sheets

Check sheets also known as data collection sheets and tally charts (Ishikawa, 1982). Check sheets are used to collect data that will be used towards solving the problem selected. Data represent inputs which will be used to provide information that will enable the right decisions to be made. Check sheets are important as it provides the facts and present information in an efficient, graphical format. This may be accomplished with a simple listing of items.

The data that should be collect is the process data which is under investigation. The design of the check sheet has to allow valuable information to be obtained. It is important to keep the check sheet as simple as possible so that the entire investigation effort is put towards collecting the right type of information. The sheet should also be designed so that data is collected over a certain time scale. The analysis of information will only become meaningful if enough data has been collected.

2.5.1 Who Should Collect The Data

The person who collects the data must fully understand the process, perhaps those who are responsible for the problem, are asked to collect the information. The data

collected must be precisely attributing to the right cause so that the analysis gives accurate outcomes (Mohamed, 2005).

2.5.2 Check Sheets Procedure

Nancy (2004), stated that, first, decide what event or problem will be observed and develop operational definitions. After that, decide when data will be collected and the period of the data that will be collected. Next, design the form so that data can be recorded simply by making check marks or tick or similar symbols and so that data do not have to be recopied for analysis. Label all spaces on the form. Test the check sheet for a short trial period to be sure it collect the appropriate data and is easy to use. Lastly, each time the targeted event or problem occurs, record the data on the check sheet.

2.6 Pareto Chart

Pareto Chart also known as Pareto Diagram or Pareto Analysis. Pareto Chart are important tools in quality improvement process. They were created by Kaoru Ishikawa, who pioneered quality management processes in the Kawasaki shipyards. Alfredo Pareto, an Italian economist (1848-1923) found that 80% of the property in Italy was owned by 20% of the population. This observation had leaded him to formulate the Pareto Principles. Pareto Principle supports the 80/20 rule, which states that 80% of problems (nonconformities or defects) are created by 20% of causes (Boon, 2010).

Pareto Chart is a bar graph. It also graphically summarizes and clearly show the differences between groups of data-often those provided within check sheet. By drawing out the Pareto Chart, the frequency of the problem can clearly stated and focused to achieve improvement. Besides, 80% problem and 20% of the causes also can be identified. Normally, the graph will be arranged in order of longest bars on the left and the shortest to the right. By this arrangement, the chart visually depicts which situations are more significant and helps prioritize the problems by arranging them in decreasing order of importance. In environment with limited resources, these diagrams will help the companies decide on the order in which they should address problems (Boon, 2010).

2.6.1 When to Use Pareto Charts

Based on Nancy (2004), Pareto Chart normally being produce when there are too many problems and causes appeared and the most significant need to be focusing. It also can be use to analyze data about the frequency of problems and the causes that appeared in a process. It also very useful and easy to be interpreted the data to others.

2.6.2 Pareto Charts Procedure

According to Nancy (2004), first, decide what categories that will use to group items than decide what measurement is appropriate. Those common measurements are frequency, quantity, cost and time. Next, decide what period of time the Pareto chart will cover, either one work cycle, 1 day or 1 week. After that, collect the data, recording the category each time or assemble data that already exist. Subtotal the measurements for each category and determine the appropriate scale for the measurements that have been collected. Mark the scale on the left side of the chart and make sure to construct and label bars for each category. Place the tallest at the far left, then the next tallest to its right and so on. If there are many categories with small measurements, they can be grouped as “other.”

Calculate the percentage for each category where the subtotal for that category divided by the total for all categories. Draw a right vertical axis and label it with percentages. Be sure the two scales match. Calculate and draw cumulative sums. Add the subtotals for the first and second categories, and place a dot above the second bar indicating that sum. To that sum add the subtotal for the third category, and place a dot above the third bar for that new sum. Continue the process for all the bars. Connect the dots, starting at the top of the first bar. The last dot should reach 100 percent on the right scale.

2.7 Flowcharts

Flowcharts shows the sequences of event in a process which are used for manufacturing and service option (Amitava, 2008). It is not statistical, but is used to

piece together how the real process is run. Seeing it visually makes identifying both inefficiencies and potential improvements easier.

A series of shapes are used to depict every step of the process; mental decisions are captured as well as physical actions and activities. Arrows depict the movement through the process. Flowcharts vary in complexity, but when used properly can prove useful for identifying bottlenecks, redundant steps, and non-value-added activities. A realistic flowchart can be constructed by using the knowledge of the person who carried out or incharge the particular process (Amitava, 2008).

2.7.1 Flowchart Procedures

First, familiarize the participants with the flow chart symbols. After that, draw the process flow chart and fill it out in detail about each element. Analyze the flow chart. Next, determine which steps can be combined, simplified, or eliminated. Lastly, finalize the flow chart (Boon, 2010).

2.7.2 Flowchart Symbols

Flowcharts usually built by using six symbols which shown in Figure 2.1. The symbols can lead to an accurate and up to date representation of the process being considered and are the best means by which complex aspects can be simplified and communicate.

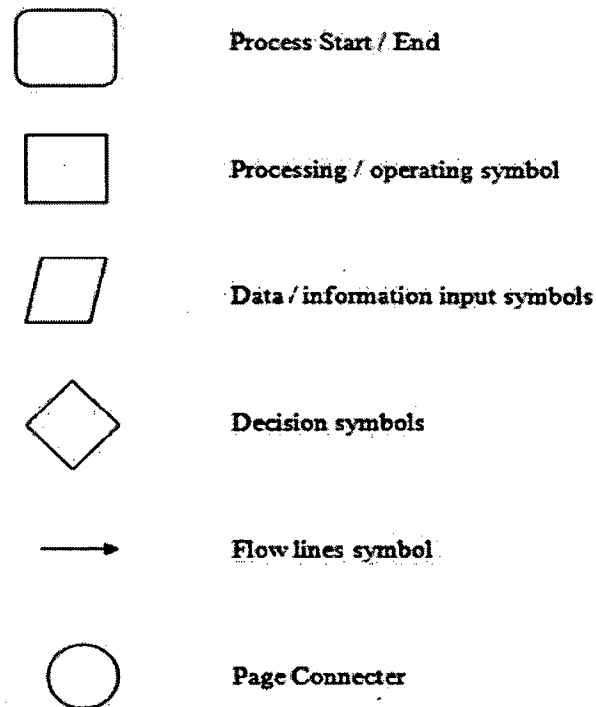


Figure 2.1: Flowcharts symbols

Source: Boon (2010)

2.8 Cause and Effect Diagram

Cause and effect diagram also known as Fish bone diagram. It's also called as Ishikawa diagrams because Kaoru Ishikawa developed them in 1943. This tool is called fishbone diagrams because they resemble one with the long spine and various connecting branches. The fishbone diagram organizes and displays the relationships between different causes for the effect that is being examined. This chart helps organize the brainstorming process. The major categories of causes are put on major branches connecting to the backbone, and various sub-causes are attached to the branches. A tree-like structure results, showing the many facets of the problem (Nelson, 1985).

2.8.1 When to Use Cause and Effect Diagram

Cause and effect diagrams used to identify possible causes in quality problem. When a production team is about to launch a new product, the factors that will affect the final product must be recognized. The diagram can depict problems before they have a chance to begin. It is also very usefull when a team's thinking tends to fall into ruts. (Nancy, 2004)

This is another tool that can be used in focused brainstorming sessions to determine possible reasons for the target problem. The brainstorming team should be diverse and have experience in the problem area. A lot of good information can be discovered and displayed using this tool (Nelson, 1985).

2.8.2 Cause and Effect Diagram Procedure

Nancy (2004), stated that clearly identify and define the problem or effect for which the causes must be identified at the very first. Then, place the problem or effect at the right or the head of the diagram and identify all the broad areas of the problem. Write in all the detailed possible causes in each of the broad areas. Normally, the causes will be 4M which is methods, machines, manpower and materials. Each cause identified should be looked upon for further more specific causes. Next, view the diagram and evaluate the main causes. Set the goals and take action on the main causes. When the group runs out of ideas, focus attention to places on the chart where ideas are few.

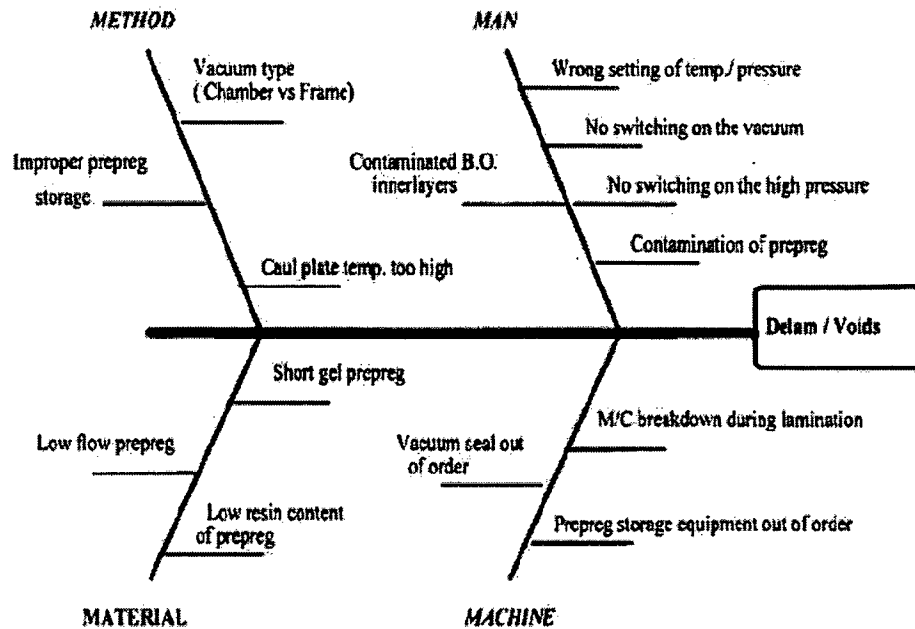


Figure 2.2: Cause and Effect Diagram of delamination / voids

Source: Card (2006)

From Figure 2.2, the effect is the delamination or voids and the causes of voids is the 4M which are Method, Man, Material and Machine. There are 3 causes from Method which is improper prepreg storage, vacuum type and high temperature of caul plate. Causes that cause by Man is the error of setting of temperature or pressure, didn't switch on the vacuum and the high pressure when using the machine, contaminated B.O. inner layers and contamination of prepreg. Material which cause voids are short gel prepreg, low flow or prepreg and low resin content of prepreg. Last but not least, the causes that made by Machine are vacuum seal out of order, machine breakdown during lamination and prepreg storage equipment out of order.

2.9 Small and Medium Enterprises (SMEs)

2.9.1 Overview

SMEs have been the backbone of economic growth of an economy in driving industrial development. Due to their sheer numbers, size and nature of operations, this segment of the economy in promoting endogenous sources of growth and strengthening the infrastructure for accelerated economic expansion and development in Malaysia has been recognised.

The National SME Development Council approved the use of common definitions for SMEs in the manufacturing, manufacturing-related services, primary agriculture and services sectors (Classification of economic activities is based on the Malaysian Standard Industrial Classification (MSIC) 2000 codes). These definitions are applied by all Government Ministries and Agencies involved in SME development, as well as by the financial institutions. The use of common definitions for SMEs will strengthen government efforts to create effective policies and support programmes for specific target, make it easier to provide technical and financial assistance to SMEs, and allow for the identification of SMEs in the various categories and levels.

2.9.2 Definition

Based on Secretariat to National SME Development Council (2005), SMEs define as a small and medium enterprise in services is an enterprise with full-time employees not exceeding 50 or annual sales turnover not exceeding RM5 million. Malaysian SMEs can be grouped into three categories which are micro, small, or medium. These groupings are decided based on either the numbers of people a business employs; or on the total sales or revenue generated by a business in a year.